39943/SAH/C715

WHAT IS CLAIMED IS:

1. A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror adjacent the substrate;

an active region including one or more quantum wells, the quantum wells being formed of InGaAsN;

a second mirror adjacent the active region, the second mirror including a tunnel junction for injecting holes into the active region,

wherein the laser emits light at a nominal wavelength of 1300 nm.

2. The vertical cavity surface emitting laser of claim 1, wherein the substrate includes GaAs.

3. The vertical cavity surface emitting laser of claim 1, wherein the tunnel junction includes a n-type layer and a p-type layer.

4. The vertical cavity surface emitting laser of claim 3, wherein the p-type layer of the tunnel junction is positioned at or near a standing wave null in optical field.

5. The vertical cavity surface emitting layer of claim 2, further comprising one or more oxide apertures, proximate to the active region, wherein the oxide aperture includes an oxidized portion therein.

6. The vertical cavity surface emitting layer of claim 5 wherein the oxidized portion of the oxide aperture comprises an aluminum oxide.

7. The vertical cavity surface emitting layer of claim 5 wherein the oxide aperture comprises a carbon doped spike positioned at or near a standing wave null in optical field.

8. The vertical cavity surface emitting layer of claim 5, further comprising a mesa
extending downward at least to the oxide aperture.

9. The vertical cavity surface emitting layer of claim 1 wherein the first and second mirrors comprise unipolar distributed Bragg reflector mirrors.

10. The vertical cavity surface emitting layer of claim 9 wherein the first and second mirrors are n-type mirrors.

11. The vertical cavity surface emitting layer of claim 1 further comprising an upper electrode above the second mirror stack and a lower electrode below the active region.

12. The vertical cavity surface emitting layer of claim 11 wherein the lower electrode includes an annular aperture therein to monitor transmitted output power of the VCSEL from light emitted through the annular aperture in the lower electrode.

13. A method of manufacturing a surface emitting laser that emits light at a nominal wavelength of 1300 nm., comprising:

forming a first mirror on a substrate;

forming an active region having one or more InGaAsN quantum wells on the substrate;

forming a current constriction proximate the active region;

forming a second mirror above the active region; and

forming a tunnel junction in the second mirror, wherein the tunnel junction comprises an n-type region and a p-type region

and the p-type region is positioned at or near a standing wave null in optical field.

14. The method of claim 13 wherein the step of forming a current constriction comprises forming oxide aperture layers proximate to said active region.

15. The method of claim 14 wherein the step of forming oxide aperture layers proximate to said active region comprises forming at least one aluminum alloy layer proximate to said active region.

16. The method of claim 15 further comprising forming a mesa downward from upper most surface of the surface emitting laser to the oxide aperture layers and oxidizing an annular portion of said oxide aperture layers.

17. The method of claim 15 wherein the step of forming oxide aperture layers further comprises doping each aluminum alloy layer with an n-type or p-type dopant.

18. The method of claim 17 wherein the step of doping the aluminum alloy layer with the p-type dopant further comprises forming a carbon doped spike in said aluminum alloy layer, wherein said carbon doped spike is positioned at or near a standing wave null in optical field.

19. The method of claim 13 further comprising doping the first and second mirrors with an n-type dopant.

20. The method of claim 13 wherein the step of forming said second mirror comprises forming one or more pairs of semiconductor mirror layers, wherein one layer in each pair has

an index of refraction that is different from the index of refraction of the other layer in each pair.

21. The method of claim 20 wherein the step of forming said semiconductor mirror layers comprises forming one quarter wavelength thick alternating layers of AlGaAs and GaAs, wherein said tunnel junction is formed into the GaAs layer nearest said active region.

22. The method of claim 13 further comprising forming an upper electrode above the second mirror and forming a lower electrode below the active region.

23. The method of claim 22 wherein the steps of forming the upper and lower electrodes comprises forming at least one of the upper and lower electrodes having an annular aperture therein.